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COST BENEFIT ANALYSIS OF VARIABLE MANAGEMENT IN WINTER WHEAT IN RESPONSE TO ON-LINE RECOGNITION OF YELLOW RUST AND FUSARIUM HEAD BLIGHT

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Significant wheat yield losses are caused by yellow rust and fusarium head blight. Financial profits are reduced from quantitative yield losses, and from reduced grain quality due to reduced proteins and high mycotoxin levels. In severe epidemics, yellow rust, can reduce yields by up to 7 tonne ha-1, whereas fusarium head blight, can result in mycotoxin contamination. The conventional approach of crop protection is a series of homogeneous rate fungicide applications (HRFA) over the entire field area. But, levels of crop disease can vary over small distances, which necessitates the need for mapping the spatial distribution of these two fungal diseases at high sampling resolution. This study reports on the use of an on-line hyperspectral sensor for mapping these two crop diseases in winter wheat, for deriving management zone (MZ) maps for variable rate fungicide application (VRFA) at timing 1 (T1) and timing 2 (T2) in response to yellow rust presence and timing 3 (T3) in response to fusarium head blight presence. The MZ maps were also used for selective harvest (SH), where healthy grain areas were proposed to be harvested separately from areas, suspected of reduced quality and mycotoxin contamination in response to yellow rust and fusarium head blight presence. The high spatial resolution data on yellow rust and fusarium head blight, were fused together with high resolution data of key soil properties, yield, and crop canopy properties. Cost-benefit analysis was carried out to calculate the economic benefits for VRFA and SH. Results showed the on-line hyperspectral sensor, coupled with partial least squares regression analysis to provide good prediction accuracies for recognition of both crop diseases. Fusarium was more successfully predicted with photo interpretation assessment (PIA) method with a residual prediction deviation (RPD) of 2.27 and R2 values of 0.82, whereas yellow rust was more successfully predicted with infield visual assessment (IVA) method with a RPD of 2.19, and R2 of 0.78. Virtual cost-benefit analysis for SH (assuming different selling price between healthy and downgraded grain) and VRFA (performed at the fungicide application timings T1, T2, and T3) showed a gross profit of combining SH and VRFA of £83.35 ha-1 year-1. Results also showed that VRFA, when compared to HRFA, allowed for reductions in fungicide application of 22.24% at T1 and T2 and 25.93% at T3. It can be recommended to adopt this management zone concept for VRFA and SH, as economic and environment benefits are feasible.

Keywords: On-line hyperspectral imagery, yellow rust, fusarium head blight, cost-benefit analysis, variable rate fungicide, selective harvest